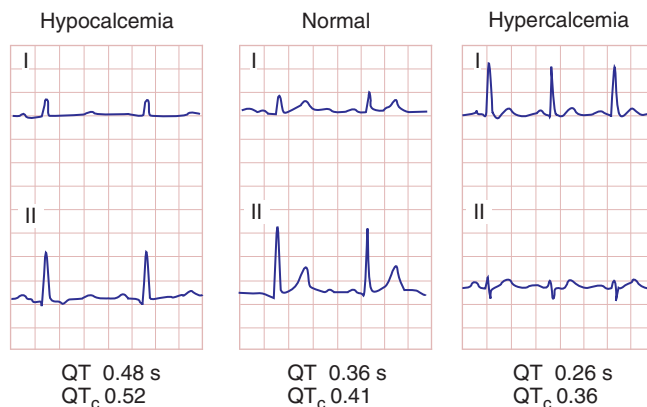


**FIGURE 268-15** The earliest ECG change with hyperkalemia is usually peaking (“tenting”) of the T waves. With further increases in the serum potassium concentration, the QRS complexes widen, the P waves decrease in amplitude and may disappear, and finally a sine-wave pattern leads to asystole unless emergency therapy is given. (After AL Goldberger et al: *Goldberger’s Clinical Electrocardiography: A Simplified Approach*, 8th ed. Philadelphia, Elsevier/Saunders, 2013.)

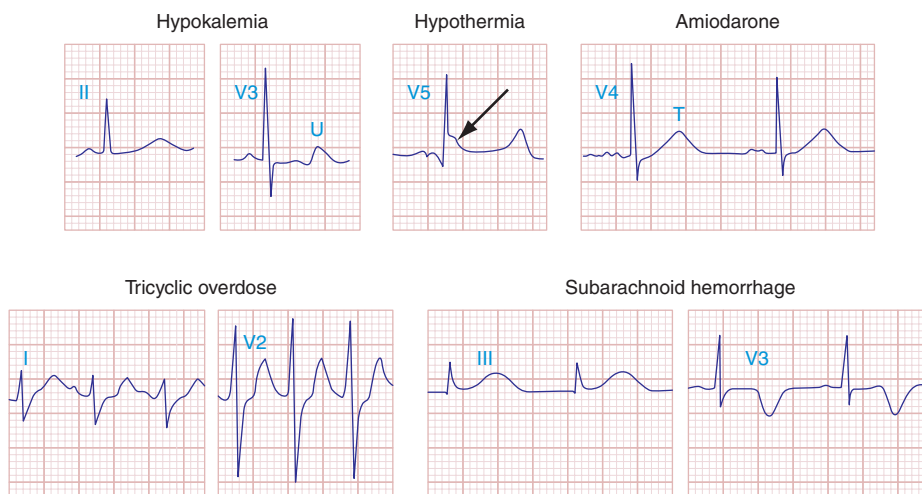
perturbations. Total electrical alternans (P-QRS-T) with sinus tachycardia is a relatively specific sign of pericardial effusion, usually with cardiac tamponade (Fig. 268-18). The mechanism relates to a periodic swinging motion of the heart in the effusion at a frequency exactly one-half the heart rate. In contrast, pure repolarization (ST-T or U wave) alternans is a sign of electrical instability and may precede ventricular tachyarrhythmias.

**CLINICAL INTERPRETATION OF THE ECG**

Accurate analysis of ECGs requires thoroughness and care. The patient’s age, gender, and clinical status should always be taken into account. Many mistakes in ECG interpretation are errors of omission. Therefore, a systematic approach is essential. The following 14 points should be analyzed carefully in every ECG: (1) standardization (calibration) and technical features (including lead placement and artifacts), (2) rhythm, (3) heart rate, (4) PR interval/AV conduction, (5) QRS interval, (6) QT/QT<sub>c</sub> intervals, (7) mean QRS electrical axis, (8) P waves, (9) QRS voltages, (10) precordial R-wave progression,



**FIGURE 268-17** Prolongation of the Q-T interval (ST-segment portion) is typical of hypocalcemia. Hypercalcemia may cause abbreviation of the ST segment and shortening of the QT interval.



**FIGURE 268-16** A variety of metabolic derangements, drug effects, and other factors may prolong ventricular repolarization with QT prolongation or prominent U waves. Prominent repolarization prolongation, particularly if due to hypokalemia, inherited “channelopathies,” or certain pharmacologic agents, indicates increased susceptibility to *torsades des pointes*-type ventricular tachycardia (Chap. 277). Marked systemic hypothermia is associated with a distinctive convex “hump” at the J point (Osborn wave, arrow) due to altered ventricular action potential characteristics. Note QRS and QT prolongation along with sinus tachycardia in the case of tricyclic antidepressant overdose.